Assignment 7 Queenie Liu q1299

Q1

71 papers 21 referees

↓

3 referees

71 x 3 = 213

1. Yes 1 ✓
2. Maybe 10 ✓
3. No 20 ✗
4. No interest 10000000X.

X_{ij} : i # of referees
j # of papers

C_{ij} : Cost for referees i to review paper j

$\sum\sum x_{ij} c_{ij}$

$$\min \sum_{i=1}^{21}\sum_{j=1}^{71} C_{ij} X_{ij}$$

$$1 \geq X_{ij} \geq 0$$

$$\sum_{i=1}^{21} x_{ij} = 3, \quad j = 1, \ldots, 71$$

$$\sum_{j=1}^{71}\sum_{i=1}^{21} x_{ij} = 213$$

HW7

November 8, 2019

[1]:
```
from gurobipy import *
import pandas as pd
import numpy as np
```

[38]:
```
paper_data = pd.read_excel('paper_data.xlsx')
new_paper_data = paper_data.drop(paper_data.columns[0],axis = 1)
print(new_paper_data)
```

```
    Referee1  Referee2  Referee3  Referee4  Referee5  Referee6 Referee7  \
0        yes        no        no        no        no       yes       no
1         no        no     maybe     maybe        no       yes       no
2         no        no        no       yes       yes        no       no
3         no        no        no     maybe       yes        no      yes
4         no        no        no        no  conflict        no       no
5         no        no     maybe       yes        no       yes       no
6         no        no  conflict        no        no       yes       no
7         no        no        no     maybe       yes        no       no
8         no        no        no        no        no        no       no
9        yes        no     maybe        no  conflict     maybe       no
10        no        no        no       yes        no        no       no
11        no        no        no     maybe        no     maybe       no
12        no        no        no     maybe        no        no       no
13        no        no        no        no        no     maybe      yes
14        no        no       yes        no        no       yes       no
15        no       yes        no        no        no        no       no
16        no        no        no        no        no  conflict       no
17        no  conflict       yes        no        no     maybe       no
18  conflict  conflict        no        no  conflict       yes      yes
19        no        no        no     maybe        no        no       no
20        no        no        no     maybe        no       yes       no
21        no        no        no        no        no        no       no
22       yes        no        no        no     maybe       yes      yes
23        no        no        no  conflict        no        no       no
24        no        no     maybe     maybe  conflict     maybe      yes
25        no       yes        no        no        no     maybe       no
26        no        no        no       yes        no        no       no
27        no       yes        no        no       yes        no       no
28        no        no        no        no        no        no       no
```

29	no	no	conflict	conflict	no	yes	no
..	...	...	...	...	...	...	...
41	no	no	no	no	no	no	no
42	no	no	no	no	no	no	no
43	no	yes	no	no	no	no	no
44	yes	no	no	no	no	no	no
45	yes	no	no	maybe	no	no	yes
46	yes	no	maybe	no	no	no	no
47	yes	no	maybe	no	no	maybe	no
48	maybe	no	no	no	conflict	maybe	no
49	no	no	no	maybe	no	maybe	no
50	maybe	no	yes	no	maybe	no	no
51	no	yes	maybe	no	yes	no	yes
52	no	no	yes	no	yes	no	no
53	no	no	no	no	conflict	no	no
54	yes	no	no	maybe	conflict	yes	no
55	no	no	conflict	conflict	no	no	no
56	no	no	maybe	no	no	yes	yes
57	no	no	no	maybe	no	yes	no
58	no	no	no	yes	yes	maybe	yes
59	no	no	no	maybe	no	no	no
60	no	no	no	yes	yes	no	no
61	no	yes	no	no	no	yes	no
62	no	yes	no	no	yes	no	no
63	maybe	no	no	no	no	yes	yes
64	no	no	no	no	no	maybe	no
65	no	yes	no	no	yes	yes	no
66	maybe	conflict	no	no	no	no	no
67	no	no	yes	no	no	maybe	no
68	yes	no	no	maybe	no	no	no
69	no	yes	no	no	maybe	maybe	no
70	no	no	no	maybe	no	no	no

	Referee8	Referee9	Referee10	...	Referee12	Referee13	Referee14	Referee15	\
0	no	no	no	...	no	no	no	no	
1	no	maybe	yes	...	no	yes	yes	yes	
2	yes	no	no	...	no	no	maybe	no	
3	no	no	no	...	no	no	no	no	
4	conflict	no	no	...	no	no	no	no	
5	no	maybe	maybe	...	no	maybe	no	maybe	
6	yes	no	yes	...	no	no	no	no	
7	no	no	no	...	no	no	no	no	
8	no	no	conflict	...	maybe	no	yes	maybe	
9	conflict	maybe	maybe	...	yes	no	yes	yes	
10	yes	no	no	...	no	no	no	no	
11	yes	yes	yes	...	maybe	no	no	no	
12	no	no	no	...	maybe	no	no	no	
13	no	maybe	yes	...	no	no	conflict	no	

14	no	no	conflict	...	maybe	no	yes	maybe
15	no	no	no	...	no	no	maybe	no
16	no	no	no	...	no	no	conflict	no
17	no	no	maybe	...	no	yes	conflict	conflict
18	conflict	no	no	...	no	no	yes	maybe
19	no	yes	conflict	...	yes	no	yes	no
20	no	yes	maybe	...	maybe	no	no	no
21	no	maybe	no	...	no	no	no	no
22	no	no	no	...	no	no	maybe	conflict
23	no	no	no	...	no	yes	no	no
24	no	no	maybe	...	maybe	no	no	no
25	no	no	no	...	no	no	maybe	no
26	no	conflict	no	...	no	no	no	no
27	no	no	no	...	no	maybe	no	no
28	no	yes	no	...	no	no	no	no
29	no	no	no	...	no	maybe	no	no
..	...	...	...	...	...	...	...	...
41	no	no	no	...	no	no	maybe	no
42	no	yes	no	...	no	no	no	no
43	no	no	no	...	no	no	no	no
44	no	maybe	no	...	no	yes	no	yes
45	no	yes	maybe	...	maybe	no	yes	conflict
46	no	no	maybe	...	no	no	maybe	no
47	no	no	maybe	...	no	no	yes	yes
48	conflict	no	conflict	...	no	no	conflict	no
49	no	no	no	...	no	no	no	no
50	no	no	no	...	no	yes	no	no
51	no	no	no	...	no	yes	no	no
52	no	no	no	...	no	yes	no	no
53	conflict	no	yes	...	no	no	no	no
54	conflict	maybe	conflict	...	no	maybe	conflict	maybe
55	no	conflict	no	...	maybe	no	no	no
56	no	conflict	no	...	no	no	no	no
57	yes	no	no	...	no	no	no	no
58	no	no	no	...	maybe	no	conflict	no
59	no	maybe	no	...	no	no	no	no
60	no	no	no	...	maybe	no	yes	no
61	no	no	no	...	no	no	no	no
62	no	no	no	...	no	no	no	no
63	no	maybe	conflict	...	no	no	yes	no
64	no	maybe	no	...	no	no	conflict	no
65	no	no	no	...	no	no	conflict	conflict
66	no	no	no	...	no	no	no	conflict
67	conflict	no	maybe	...	no	yes	conflict	no
68	no	no	conflict	...	no	yes	no	conflict
69	no	no	no	...	no	yes	no	no
70	yes	no	no	...	no	no	no	no

	Referee16	Referee17	Referee18	Referee19	Referee20	Referee21
0	no	no	no	no	yes	no
1	no	no	no	no	no	maybe
2	no	yes	no	no	maybe	maybe
3	no	yes	no	no	no	no
4	no	no	no	no	no	no
5	conflict	no	yes	no	no	no
6	no	no	no	no	conflict	no
7	no	maybe	no	no	no	no
8	no	maybe	yes	no	no	conflict
9	no	no	no	yes	no	maybe
10	no	no	yes	yes	no	no
11	no	no	no	yes	no	yes
12	no	yes	no	yes	maybe	maybe
13	no	no	no	yes	no	no
14	yes	no	no	yes	no	conflict
15	yes	no	no	no	maybe	no
16	no	no	no	no	no	no
17	no	no	no	no	no	no
18	no	no	no	yes	yes	no
19	no	no	yes	no	no	conflict
20	yes	maybe	conflict	no	no	no
21	conflict	no	yes	no	no	no
22	no	no	no	yes	yes	no
23	no	no	no	no	conflict	no
24	no	maybe	no	yes	maybe	no
25	no	no	no	no	no	maybe
26	no	no	no	no	maybe	no
27	no	no	no	yes	maybe	yes
28	no	no	yes	no	no	no
29	no	no	no	no	conflict	no
..	...	...	...	...	...	...
41	no	maybe	no	no	no	no
42	no	no	no	no	no	no
43	no	no	no	no	no	maybe
44	no	no	yes	no	no	no
45	maybe	maybe	maybe	no	no	no
46	no	no	no	no	no	no
47	maybe	no	no	no	no	no
48	no	no	no	yes	no	conflict
49	no	no	no	no	no	maybe
50	no	no	no	conflict	maybe	yes
51	no	no	no	yes	maybe	maybe
52	no	no	no	no	no	no
53	no	no	no	no	no	no
54	yes	maybe	no	yes	no	no
55	no	no	yes	no	conflict	no
56	no	no	no	no	no	no

```
57        no        no        no        no        no        no
58        no        no        no        no     maybe        no
59        no        no        no        no     maybe        no
60        no     maybe        no        no     maybe        no
61        no        no        no        no        no        no
62        no        no        no        no        no        no
63        no     maybe        no        no        no  conflict
64        no        no       yes        no     maybe        no
65        no        no        no        no     maybe       yes
66       yes        no        no       yes        no       yes
67  conflict        no        no       yes        no        no
68        no        no        no        no        no       yes
69        no        no        no        no     maybe       yes
70        no        no     maybe        no     maybe        no

[71 rows x 21 columns]
```

[39]:
```
categories = set()
for name,item in new_paper_data.iteritems():
    categories.update(list(item.unique()))
print (categories)
```

```
{'yes', 'maybe', 'no', 'conflict'}
```

[74]:
```
myModel = Model("hw7Q1")
c = [[0 for j in range(21)] for i in range(71)]
myVar = [[0 for j in range(21)] for i in range (71)]
#print (c)
#print(myVar)
for i in range(71):
    for j in range(21):
        if new_paper_data.iloc[i,j] == "yes":
            c[i][j] = 1
        if new_paper_data.iloc[i,j] == "maybe":
            c[i][j] = 10
        if new_paper_data.iloc[i,j] == "no":
            c[i][j] = 20
        if new_paper_data.iloc[i,j] == "conflict":
            c[i][j] = 10000000
for i in range(71):
    for j in range(21):
        curVar = myModel.addVar(vtype = GRB.CONTINUOUS, name = "P" + str(i+1) +␣
 ↪"R" + str(j+1), ub = 1)
        myVar[i][j] = curVar
myModel.update()
```

[70]:
```
objExpr = LinExpr()
for i in range(71):
    for j in range(21):
        curVar = myVar[i][j]
        objExpr += c[i][j] * curVar
myModel.setObjective(objExpr, GRB.MINIMIZE)
for i in range(71):
    constExpr = LinExpr()
    for j in range(21):
        constExpr += 1 * myVar[i][j]
    myModel.addConstr(lhs = constExpr, sense = GRB.EQUAL, rhs = 3, name = "P" +␣
 ↪str(i+1))
constExpr = LinExpr()
for i in range(71):
    for j in range(21):
        constExpr += 1 * myVar[i][j]
myModel.addConstr(lhs = constExpr, sense = GRB.EQUAL, rhs = 213, name = "R")
myModel.update()
```

[71]:
```
myModel.write(filename = 'Paper_Data.lp')
myModel.optimize()
print('Optimal Objective:\n' + str(myModel.ObjVal))
print('Optimal Solution:')
allVars = myModel.getVars()
for var in allVars:
    print(var.varName + " " + str(var.x))
```

```
Optimize a model with 144 rows, 1491 columns and 5964 nonzeros
Coefficient statistics:
  Matrix range     [1e+00, 1e+00]
  Objective range  [1e+00, 1e+07]
  Bounds range     [1e+00, 1e+00]
  RHS range        [3e+00, 2e+02]
Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    9.6500000e+02   0.000000e+00   0.000000e+00      0s

Solved in 0 iterations and 0.02 seconds
Optimal objective  9.650000000e+02
Optimal Objective:
965.0
Optimal Solution:
P1R1 1.0
P1R2 0.0
P1R3 0.0
P1R4 0.0
P1R5 0.0
P1R6 1.0
P1R7 0.0
```

	Referee1	Referee2	Referee3	Referee4	Referee5	Referee6	Referee7	Referee8
Paper1	1	0	0	0	0	1	0	0
Paper2	0	0	0	0	0	0	0	0
Paper3	0	0	0	0	1	0	0	1
Paper4	0	0	0	0	1	0	1	0
Paper5	0	0	0	0	0	0	0	0
Paper6	0	0	0	1	0	1	0	0
Paper7	0	0	0	0	0	1	0	1
Paper8	0	0	0	1	1	0	0	0
Paper9	0	0	0	0	0	0	0	0
Paper10	1	0	0	0	0	0	0	0
Paper11	0	0	0	0	0	0	0	1
Paper12	0	0	0	0	0	0	0	0
Paper13	0	0	0	0	0	0	0	0
Paper14	0	0	0	0	0	0	1	0
Paper15	0	0	1	0	0	0	0	0
Paper16	0	1	0	0	0	0	0	0
Paper17	1	0	0	0	0	0	0	0
Paper18	0	0	1	0	0	0	0	0
Paper19	0	0	0	0	0	0	0	0
Paper20	0	0	0	0	0	0	0	0
Paper21	0	0	0	0	0	1	0	0
Paper22	0	0	0	0	0	0	0	0
Paper23	1	0	0	0	0	0	0	0
Paper24	0	0	0	0	0	0	0	0
Paper25	0	0	0	0	0	0	1	0
Paper26	0	1	0	0	0	0	0	0
Paper27	0	0	0	1	0	0	0	0
Paper28	0	1	0	0	0	0	0	0
Paper29	1	0	0	0	0	0	0	0
Paper30	0	0	0	0	0	1	0	0
Paper31	0	0	0	0	1	1	0	0
Paper32	0	0	0	0	0	1	0	0
Paper33	0	0	0	0	0	1	0	0
Paper34	1	0	0	0	0	0	0	0
Paper35	0	0	1	1	0	0	0	0
Paper36	0	0	0	0	0	0	1	0
Paper37	0	1	0	0	0	0	0	1
Paper38	0	0	0	0	0	0	0	0
Paper39	1	0	0	0	0	0	0	0
Paper40	0	0	1	0	0	0	0	1
Paper41	1	1	0	0	0	0	0	1
Paper42	1	0	0	0	0	0	0	0
Paper43	1	1	0	0	0	0	0	0
Paper44	1	1	0	0	0	0	0	0
Paper45	1	0	0	0	0	0	0	0
Paper46	1	0	0	0	0	0	0	0
Paper47	1	0	0	0	0	0	0	0

Paper48	1	0	0	0	0	0	0	0
Paper49	1	0	0	0	0	1	0	0
Paper50	0	0	0	1	0	1	0	0
Paper51	0	0	0	0	0	0	0	0
Paper52	0	1	0	0	0	0	0	0
Paper53	0	0	0	0	1	0	0	0
Paper54	0	0	0	0	0	0	0	0
Paper55	0	0	0	0	0	0	0	0
Paper56	0	0	0	0	0	0	0	0
Paper57	0	0	1	0	0	1	1	0
Paper58	0	0	0	1	0	1	0	1
Paper59	0	0	0	1	1	0	0	0
Paper60	0	0	0	0	0	0	0	0
Paper61	0	0	0	1	1	0	0	0
Paper62	1	1	0	0	0	1	0	0
Paper63	1	1	0	0	1	0	0	0
Paper64	0	0	0	0	0	1	1	0
Paper65	0	0	0	0	0	0	0	0
Paper66	0	0	0	0	1	1	0	0
Paper67	0	0	0	0	0	0	0	0
Paper68	0	0	1	0	0	0	0	0
Paper69	1	0	0	0	0	0	0	0
Paper70	0	1	0	0	0	0	0	0
Paper71	0	0	0	0	0	0	0	1

Referee9	Referee10	Referee11	Referee12	Referee13	Referee14	Referee15	Referee16	Referee17
0	0	0	0	0	0	0	0	0
0	1	0	0	1	0	1	0	0
0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1
0	0	0	0	0	1	0	0	1
0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	1
0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	1	0	1	0
0	0	0	0	0	0	0	0	0
0	1	0	0	1	0	0	0	0
0	0	1	0	0	0	0	0	0
1	0	0	1	0	0	0	0	0
1	0	0	0	0	0	0	1	0
1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	1	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	1	0	0
0	0	0	0	0	1	0	1	0
0	0	0	0	0	0	0	0	1
0	0	0	1	0	0	0	0	1
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	1
1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0
1	0	0	0	0	1	0	0	0
0	1	0	0	0	1	0	0	0

0	0	0	0	0	1	1	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0
0	0	1	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0
0	1	0	0	0	0	0	0	0
0	0	1	0	0	0	0	1	0
0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0
1	0	1	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0
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0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0
0	0	0	0	1	0	0	0	0
0	0	0	0	1	0	0	0	0
0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

Referee18	Referee19	Referee20	Referee21
0	0	1	0
0	0	0	0
0	0	0	0
0	0	0	0
0	1	1	0
1	0	0	0
0	0	0	0
0	0	0	0
1	0	0	0
0	1	0	0
1	1	0	0
0	1	0	1
0	1	0	0
0	1	0	0
0	1	0	0
0	0	0	0
0	0	1	1
0	0	0	0
0	1	1	0
1	0	0	0
0	0	0	0
1	0	0	1
0	1	1	0
0	1	0	0
0	1	1	0
0	0	0	1
0	0	1	1
0	1	0	1
1	0	0	0
0	1	0	0
0	0	0	0
1	0	0	1
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	1
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1	0	1	0
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0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	1
1	0	0	0
0	0	0	0
0	0	0	0

0	0	0	0
0	1	0	0
0	0	0	1
0	0	0	1
0	1	0	0
0	0	0	0
0	1	0	1
0	1	0	0
1	0	0	1
0	0	0	0
0	0	0	0
0	0	0	0
0	0	1	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
1	0	1	0
0	0	0	1
0	1	0	1
0	1	0	0
0	0	0	1
0	0	0	1
1	0	1	0

Q2

$$\begin{aligned} \max \quad & 5x_1 + 9x_2 + 4x_3 \\ \text{st} \quad & 3x_1 + 4x_2 + 5x_3 \leq 7 \\ & x_1 + 2x_2 + x_3 \leq 3 \\ & x_1 + 2x_3 \leq 1 \\ & x_1 + x_2 \leq 1 \\ & x_1, x_2, x_3, x_4 \geq 0 \end{aligned}$$

(a)
$$\begin{aligned} \min \quad & 7y_1 + 3y_2 + y_3 + y_4 \\ \text{st} \quad & 3y_1 + y_2 + y_3 + y_4 \geq 5 \\ & 4y_1 + 2y_2 + y_4 \geq 9 \\ & 5y_1 + y_2 + 2y_3 \geq 4 \\ & y_1, y_2, y_3, y_4 \geq 0 \end{aligned}$$

(b)
$$\begin{aligned} \max \quad & -7y_1 - 3y_2 - y_3 - y_4 \\ \text{s.t} \quad & -3y_1 - y_2 - y_3 - y_4 \leq -5 \\ & -4y_1 - 2y_2 - y_4 \leq -9 \\ & -5y_1 - y_2 - 2y_3 \leq -4 \\ & y_1, y_2, y_3, y_4 \geq 0 \end{aligned}$$

Dual

$$\begin{aligned} \min \quad & -5z_1 - 9z_2 - 4z_3 \\ \text{s.t} \quad & -3z_1 - 4z_2 - 5z_3 \geq -7 \\ & -z_1 - 2z_2 - z_3 \geq -3 \\ & -z_1 - 2z_3 \geq -1 \\ & -z_1 - z_2 \geq -1 \\ & z_1, z_2, z_3 \geq 0 \end{aligned}$$

(c)
$$\begin{aligned} \max \quad & 5z_1 + 9z_2 + 4z_3 \\ & 3z_1 + 4z_2 + 5z_3 \leq 7 \\ & z_1 + 2z_2 + z_3 \leq 3 \\ & z_1 + 2z_3 \leq 1 \\ & z_1 + z_2 \leq 1 \\ & z_1, z_2, z_3 \geq 0 \end{aligned}$$

$$\begin{aligned} & 7x_1 + 3x_2 + x_3 + x_4 \\ \text{s.t} \quad & 3x_1 + x_2 + x_3 + x_4 \geq 5 \\ & 4x_1 + 2x_2 + x_4 \geq 9 \\ & 5x_1 + x_2 + 2x_3 \geq 4 \\ & x_1, x_2, x_3, x_4 \geq 0 \end{aligned}$$